

HISTORY

A select history of modular synthesizers

Most creations build on the musings and discoveries of people who came before. The same is true with modular synthesis. Therefore, we thought it would be interesting to share a few of the threads that have led to where we are now.

Interestingly, although a lot of synthesizer-like instruments were created over the course of nearly 200 years before modular synths first appeared, it can't be said that modulators directly descended from them. Instead, the motivation for the creation of early modular synths came from the desire of composers to have a more immediate tool to work with, compared to the audio test signal generators and tape splicing techniques they were using in the electronic music studios of the 1950s. Here we share a few of the more pivotal stories of the evolution of modular synths, as well as 'points in time' where a lot of influential companies both old and new got their start.

We had fun researching and interviewing people for this section; see the acknowledgements for a list of credits.

History is a tricky business

Memories are not always accurate; two memories may contradict each other - especially when they come from different sides of a story. For example, we found quotes that dated the creation of the first Buchla Music Box (Don didn't call them 'synthesizers') to anywhere from 1961 to 1966! Where possible, we've used documents rather than memories to help us piece together the actual timeline. Where that wasn't possible, we're purposely indistinct about exact dates.

The first steps

The first mention of a word for "electricity" appears in 1600. It takes 276 years before we learn to make it vibrate like an oscillator, and 360 years until we have a voltage-controller oscillator. Between the two, a lot of attempts are made to create electric musical instruments, and many famous composers support their development. But it's only at the end of this period that the concept of patching modules together to alter and even create sound in real time becomes a reality.

1876

Inspired by a discovery his nephew made while playing with a battery and a bathtub, Elisha Gray creates an electromagnetic circuit that could vibrate; some might say this was the first electric 'oscillator.' He creates a set of circuits tuned to different frequencies and connects them to a rudimentary keyboard, creating the 'Musical Telegraph' (also known as the 'Electro-Harmonic Telegraph'). These oscillations can be transmitted over telegraph or telephone wires to a remote location.

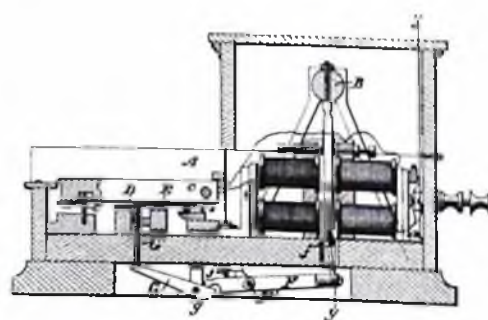
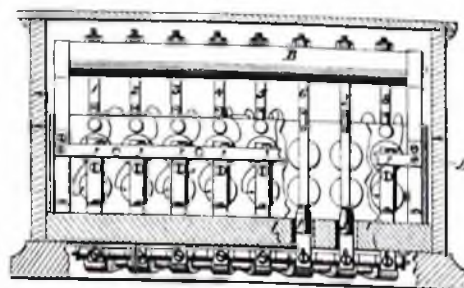


Fig. 3.



1922

Famous composer Edgar Varese writes "What we want is an instrument that will give us a continuous sound at any pitch. The composer and the electrician will perhaps have to labor together to get it."

1937

Artist and composer John Cage, in his credo *The Future of Music*, expresses disdain for previous electronic instruments that have attempted to reproduce the sound of other instruments. Instead, he states "The special property of electrical instruments will be to provide complete control of the overtone structure of tones as opposed to noises and to make these tones available in any frequency, amplitude, and duration."

1946

Composer and performer Raymond Scott establishes Manhattan Research, and announces he will "design and manufacture electronic music devices and systems." These include devices such as ring modulators, wave, tone and envelope shapers, and filters "for the creation of electronic music and Musique Concrète." A young Robert Moog creates some circuits for Raymond in the 50s, and credits Raymond with possibly building the first sequencer "with relays, motors, steppers, and electronic circuits."

1948

Alan R. Pearlman - future founder of ARP Instruments - is a student at Worcester Polytechnic Institute. He writes a paper stating "The electronic instrument's value is chiefly as a novelty. With greater attention on the part of the engineer to the needs of the musician, the day may not be too remote when the electronic instrument may take its place as a versatile, powerful, and expressive instrument."

1953

With the help of his father, Robert Moog - age 19 - founds R.A. Moog Co. to manufacture Theremin kits.

1955

In an attempt to replace union musicians, US entertainment giant RCA develops the *Mark I Synthesizer*. Borrowing from the top-octave divide-down technology of organs, it contained 12 tube-based oscillators to create the notes in an octave. These waveforms were then processed through frequency dividers to create the other octaves, as well as a series of filters, modulators, and resonators.



Photo: Computer Center Music Archives
The Columbia Electronic Music Center

Composing with it requires the manual setting of over 200 controls and using a laborious punch-tape entry system. Capturing the results involves recording six tracks onto one record cutting lathe, which are then bounced down to a second cutting lathe. The *Mark II* follows shortly thereafter, and is donated to the Columbia-Princeton Electronic Music Center, where it still resides (it was recently restored).

1959-60

Harald Bode develops the *Audio System Synthesizer*. The idea is to create a system that could serve all the imagined needs for film or TV sound production. The resulting device contains a series of modules integrated with a reel-to-reel tape deck. It allows a composer to patch those modules - including a ring modulator, filter, and reverb in any order to modify existing sounds or theoretically generate new ones (although the system did not appear to have an oscillator). The resulting sound can be recorded back to tape.



Photo: Peer Bode

1960

Harald Bode is said to create the first voltage-controlled oscillator while working for Wurlitzer Organ Company.

It all comes together

The mid-1960s see an explosion of activity as electronic music composers team up with interested engineers to create the first generation of what we now refer to as "modular music synthesizers" (even though two of the founding fathers were reluctant to use that name at the time).

1961

The San Francisco Tape Music Center (SFTMC) is founded by composers Morton Subotnick, Ramon Sender, and Pauline Oliveros as a way for them to pool their equipment.

Mort knows that the Rockefeller Foundation had funded the Columbia-Princeton studio, and asks Norman Lloyd at the Foundation about funding the SFTMC as well. According to Mort, the reply is "There will never be enough interest in electronic music in the United States for two studios" and suggests it would be less expensive to simply fly people to New York than to build a second studio.

1963

Composer Herb Deutsch - a user of one of Robert Moog's theremins - introduces himself to Bob at a music-education conference in Rochester, New York. Herb proposes "Wouldn't it be interesting to think about designing a new instrument - a 'synthesizer'." Bob admits he doesn't know much about electronic music, and is leery of using the synthesizer name as it was currently in use by RCA. To learn more about electronic music, Herb invites Bob to a concert early next year, and Bob makes plans to attend.

Back at the San Francisco Tape Music Center (SFTMC), Morton Subotnick and Ramon Sender brainstorm the creation of a 'black box' to make it easier to create their music. In their dreams, it's an affordable electronic music 'easel' someone could even have at home. Their idea is based on a rotating disc with holes in it that would hide or expose a photocell behind it, translating their punch marks into sound. Mort even starts studying electronics books in the hope of designing it himself.

It's been hard to nail down this next encounter: Some say it happened in 1963; others are certain it happened in 1964 after Don Buchla created a ring modulator for the SFTMC.



Photo used with permission of the Bob Moog Foundation.

Bob Moog and Herb Deutsch experimenting with a later-generation Moog modular system.

Mort and Ramon describe their idea for their black box to Don. Don builds it for them, but explains that this was not the right way to go. So they start collaborating, bouncing ideas off of each other and sketching them out on paper. Ramon Sender lobbies for a piano-style keyboard, but both Mort and Don are against the idea. They ask Don how much he needs to build it, and Don replies \$500. Mort asks the Rockefeller Foundation for funding of this idea, and reportedly they again say "no."

1964

Robert Moog attends a concert of tape and electronic music - including works by composer Herb Deutsch - in early 1964. After the concert, Herb and Bob talk about creating what Herb calls a "small and affordable music synthesizer." Herb's goal is to create something that was easier and more immediate to control than the electronic test equipment oscillators he had previously been using. Bob takes up the challenge, and writes a letter of intent that Herb uses to secure a \$200 grant from Hofstra University.

Returning to rural Trumansburg, New York, Bob starts work, and creates a pair of voltage-controlled oscillators and amplifiers. Herb comes out to visit Bob, and they refine Bob's initial ideas over the course of several weeks. After some more work, later in 1964 Bob prepares a tape demonstrating

what he jokingly calls "the Abominatron" and ships Herb the prototype. It contains two VCOs, two VCAs, and a polyphonic keyboard. Herb composes *Jazz Images*, a *Worksong* and *Blues*, which is the first piece ever recorded using the Moog Synthesizer.

Vladimir Ussachevsky, director of the electronic music lab at Columbia-Princeton, suggested the instrument not have a keyboard; Bob initially agrees. Moog employee Amos Gaynes later recounts that Bob personally thought the piano keyboard was limiting - especially for live performance expression. Although Herb himself creates avant-garde music, he also played jazz, and suggests to Bob that "a keyboard is a good idea ... putting a keyboard on the synthesizer would certainly make it a more sellable product."

Later that year, Bob gets the opportunity to show his *Moog Synthesizer* at the October 1964 AES Convention. Modern dance choreographer Alwin Nikolais - who composed his own scores as well - sees it, makes some suggestions, and orders one. English-American composer and musician Eric Siday - inventor of the 'sound logo' - also orders one, recognizing its potential for jingle production as well as for more serious composition. Eric notes "The ear of the world is satiated by conventional music. To grasp a listener today, you have to give him something new."

1965

The Rockefeller Foundation assigns a different person - Boyd Compton - to the San Francisco Tape Music Center project. He visits, and gets swept up in the excitement. Afterwards, the SFTMC submits a proposal to the Rockefeller Foundation for a \$15,000 grant. It includes a line item of \$500 for "expansion of the studio console" to help pay for Don Buchla to create the instrument they've been talking about. This time, it is approved.

Fortunately, Don has already started work on the individual modules. Don delivers the 100 Series *Modular Electronic Music System* to the SFTMC in November 1965. Excited by the arrival of this new toy, studio engineer and composer Bill Maginnis stays up that entire first night, using the Buchla to create his composition *Flight*.

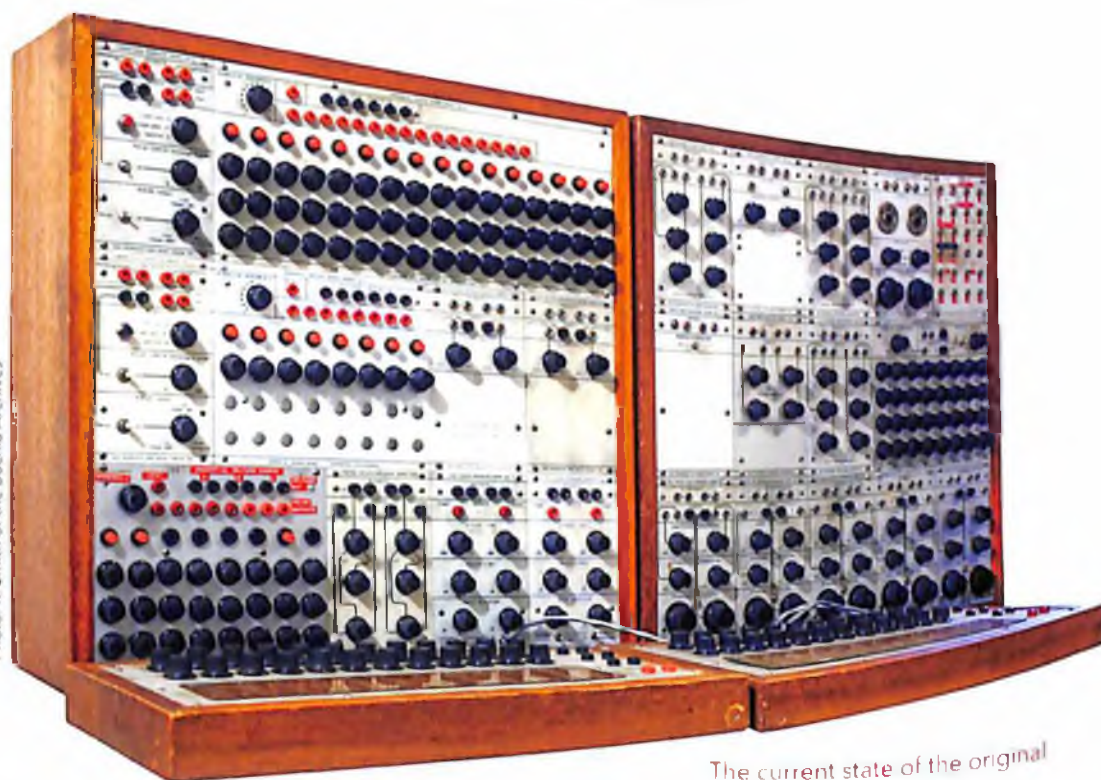
The original *Buchla Box* - Don didn't call it a 'synthesizer', he considered his creations to be instruments in their own right - includes the *Model 114 Touch Controlled Voltage Source (TCVS)*, or 'touch keyboard' for short). The TCVS has ten identical touch-sensitive keypads. This is specifically requested because Mort and Ramon have acquired a tape-based answering machine device with ten separate tape transports, and want a way to fade those tracks in and out.

Photo used with permission of the Bob Moog Foundation.



Prototype Moog modules.

Photo: R. Smith of the Buchla Archives



The current state of the original Buchla Box at Mills College.

Each 'key' of the TCVS can control each tape transport's playback speed. It also contains what is probably the first sequencer for sending voltage control to modules. In Don's words, "when you invent voltage control, you invent ways of generalizing voltages for control."

Electronic Music Studios (EMS) is founded by Peter Zinovieff, built in a shed at his house in Putney (a district in southwest London, England). Zinovieff manages to acquire two DEC PDP8 mini-computers - "the first computer in the world in a private house," according to Peter - and uses them to voltage-control an array of analog synthesis equipment.

In September 1965, the first public live performance using a Moog synthesizer takes place at the Town Hall in New York City.

1966

Don Buchla plays at several of Ken Kesey's Acid Tests. The pinnacle is the Trips Festival at the San Francisco Longshoreman's Union Hall, running January 21 to 23. Don plays electronic sounds between acts. Ken Kesey later acquires his own four-module Buchla Box (pictured below) for processing sounds himself.



Photo courtesy of National Music Centre (NMC)
Object Number: 2003.01.01

The Rockefeller Foundation - now obviously agreeing there is need for more than one electronic music studio in the US - approves a \$200,000 grant, and the SFTMC is merged with the Mills College Chamber Music Center in Oakland California, becoming the Mills Center for Contemporary Music.

Later this same year, Morton Subotnick gets a lucrative contact with Nonesuch Records to create *Silver Apples of the Moon*. He orders his own Buchla 100 Series Modular Electronic Music System to use in New York for its composition.

François Coupigny creates the five-oscillator *Coupigny Synthesizer* in France. It is integrated into the 24-track mixing console of Studio 54 at the Groupe de Recherche de Musique Concrète (GRM), allowing it to control tape recorders plus interface with other external equipment. It is modular, using a pin matrix system akin to what is seen later in EMS designs.

The *Coupigny Synthesizer* is said to be the first synth Jean-Michel Jarre ever used. It is still functioning at the GRM studio today; JMJ used it on his album *Electronica*.



Photo: Trevor Wilson

1967

Morton Subotnick's *Silver Apples of the Moon* is released, and is said to be the first piece of electronic music commissioned by a record company.



In May of this year, the first recording to feature the Moog - Mort Garson's *The Zodiac: Cosmic Sounds* - is released. The Moog programmer is listed as Paul Beaver. Paul and his musical partner Bernard Krause become the West Coast representatives for Moog, introducing it to bands ranging from the Beatles to The Doors to Simon and Garfunkel to The Monkees. They perform in numerous recording sessions up and down the West Coast, and release their own albums as well.



The first Beaver & Krause effort is *The Nonesuch Guide to Electronic Music*, which is an educational album using the Moog. It comes with a detailed booklet that includes the original inspiration for the patch notation scheme we use in this book. Nonesuch is the same label that commissioned Mort Subotnick's *Silver Apples of the Moon*.

The PULSA Group - a collaborative of artists and faculty at Yale University in New Haven, Connecticut - are interested in interactive computer art through viewer-activated light and sound installations, and dream up a voltage-controlled hybrid digital and analog audio synthesizer that can execute 'generative' (p. 260) as well as pre-planned multimedia compositions. Two of their members - Peter Kindlmann and Paul Fuge - spearhead the design work on the one-off *PULSA Synthesizer*.

Innovations in the *PULSA Synthesizer* include:

- Voltage control "for all important parameters" including frequency, amplitude, independent attack and decay times as well as clocking.
- Elimination of the distinction between audio voltage levels and control voltage levels.
- A highly modularized patching scheme based on patch cables with pins. Even attenuators are shared and separate, replacing potentiometers on the modules themselves. Capacitors are plugged into pin jacks on the front of some modules for major changes in the timing of some functions, i.e. to convert an audio waveform to a slow control function.
- Generation of timing and fixed or pseudo-random patterns by shift registers and other logic circuitry.
- Four-quadrant analog multipliers are a fundamental building block in the *PULSA*. They can become 'VCA's, envelope generators or ring modulators (p. 187), depending on what kind of signals are used as inputs.



Paul Fuge of Yale working on the PULSA Synthesizer.

Two people fundamental to the development of modular and semi-modular synths later have contact with this machine. It affects one of them deeply, which is our next story.

1968

Serge Tcherepnin moves to the US from Europe, and starts to hang out with the PULSA Group at Yale University. Serge recounts that the *PULSA Synthesizer* "gave a direction to my own future work, and not only on the technical level, but also humanly and aesthetically."

Later in 1968, Serge is invited by Morton Subotnick to join the Intermedia Program at New York University. During this time, Serge designs and builds a variety of circuits for Morton and the other artists and musicians. "I had carte blanche to pursue my DIY interest in electronics, to set up a test bench, and to see where that led."



Photo: Richard Bugg

Although his official duties had little to do with Morton or his Buchla 100 system, it still has a great impact on Serge. "I learned a lot of my electronics from Don's schematics, and they set me on the course that made my designs so different from everybody else's."

"What struck me upon examining Don's designs, is how much very interesting stuff was hidden away in order to realize a given function. Take one of his VCOs for example. The VCO consisted of several blocks strung together, an sawtooth oscillator, a full wave rectifier producing a triangle wave, a diode shaper to turn the triangle into a sine wave, and a comparator circuit to produce pulse waves. All of it worked beautifully to make an elegant module, but so much of it was hidden, unable to be accessed, and very interesting stuff indeed. That's why from the beginning, I was determined to make sub-functions such as comparators, rectifiers, waveshapers, bi-directional routers, and peak and trough tracers available for use by the musician interested in sonic DIY."

David Friend - co-founder and eventual president of ARP Instruments - also has contact with the *PULSA Synthesizer*, but is more affected by his work at the Yale Electronic Music Lab. At the request of composer Mel Powell, David creates an audio stream sequencer. Featuring multiple inputs, it can switch between primitive electronic sound generators as well as pre-recorded sounds from tape recorders, using both normal and random patterns. This allows the creation of rapid changes between audio sources with far less work than splicing tape.

Wendy Carlos releases *Switched-On Bach*, recorded using a Moog modular customized to Wendy's specifications. It is one of the best-selling classical records of all time, and wins three Grammy Awards in 1970.



A second wave

After the Moog and Buchla modular synths appear, several other manufacturers are encouraged to join the fray - especially after the release of one particularly successful album.

1969

Switched-On Bach - and most electronic music albums to date - are studio creations. To convince people that the Moog could also be a performance instrument, Moog organizes a *Jazz in the Garden* concert at the Museum of Modern Art in New York. It features four Moog modular synthesizers playing jazz in a live setting. As it's hard to reprogram a modular synth during a live performance, special preset modules are built which can take over the front panel controls. The lead Moog is later sold to Keith Emerson, and forms the basis for his famous modular Moog.

David Friend joins ARP Instruments, initially designing the 1050 *Mix-Sequencer* and 1027 *10-stage Clocked Sequential Controller*, plus a sequencer expander. Echoing the audio stream sequencer he designed while at Yale, they feature normal patterns as well as random playback. David eventually becomes ARP's president, and is involved in instruments including the ARP 2600 semi-modular and the ARP *Odyssey*. He describes their overall goal as "solving existing problems for composers."

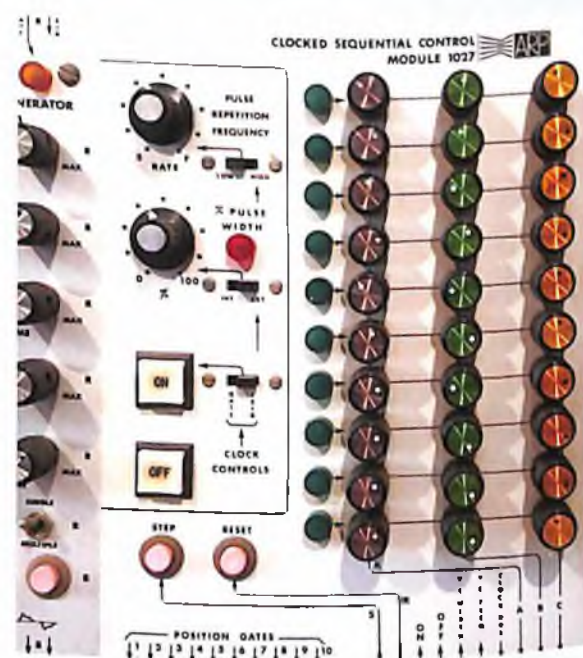


Photo courtesy Jondent

Composer Don Banks spends an evening with Peter Zinovieff of Electronic Music Systems, where "I complained bitterly about the lack of facilities for composers to learn the language of electronic music. Peter, as generous as ever, said he would ask David (Cockerell) to design a kind of instrument which would incorporate a number of facilities which one would need to know about in the production and treatment of sound." The result becomes known as the *Don Banks Music Box (DBMB)*, which in retrospect is referred to as the *EMS Voltage Controlled Synthesizer (VCS) model 1*. This evolves into the famous *EMS VCS3*, which is released for commercial sale.



Collection: Museum of Applied Arts and Sciences. Photo: Marinco Kojdanovski

1970

The ARP 2000 series modular synthesizer is introduced at the Fall AES show in New York.

One of its most striking features is rows of switches above and below the modules. David Friend explains this is a solution to the normal "maze of patch chords that made it very difficult to understand what was going on, and was cumbersome." These switch matrices take inputs and outputs indicated by the front panel graphics for each module, and places them on a series of connection buses shared by the other modules. Unfortunately, this innovative system suffers from crosstalk between adjacent busses.

Like Bob Moog and Don Buchla, Alan Pearlman - a big fan of Morton Subotnick's early records - is advised that he doesn't need a keyboard, as "these instruments were good for atonal music, anyhow." But, he sees that Wendy Carlos' *Switched-On Bach* is outselling Subotnick, so he "kinda figured the Moog approach was the better approach."

The initial instruments are offered in a variety of configurations numbered 2000 through 2007, all with a three-voice keyboard controller.



Photo: Bukowski Auctions

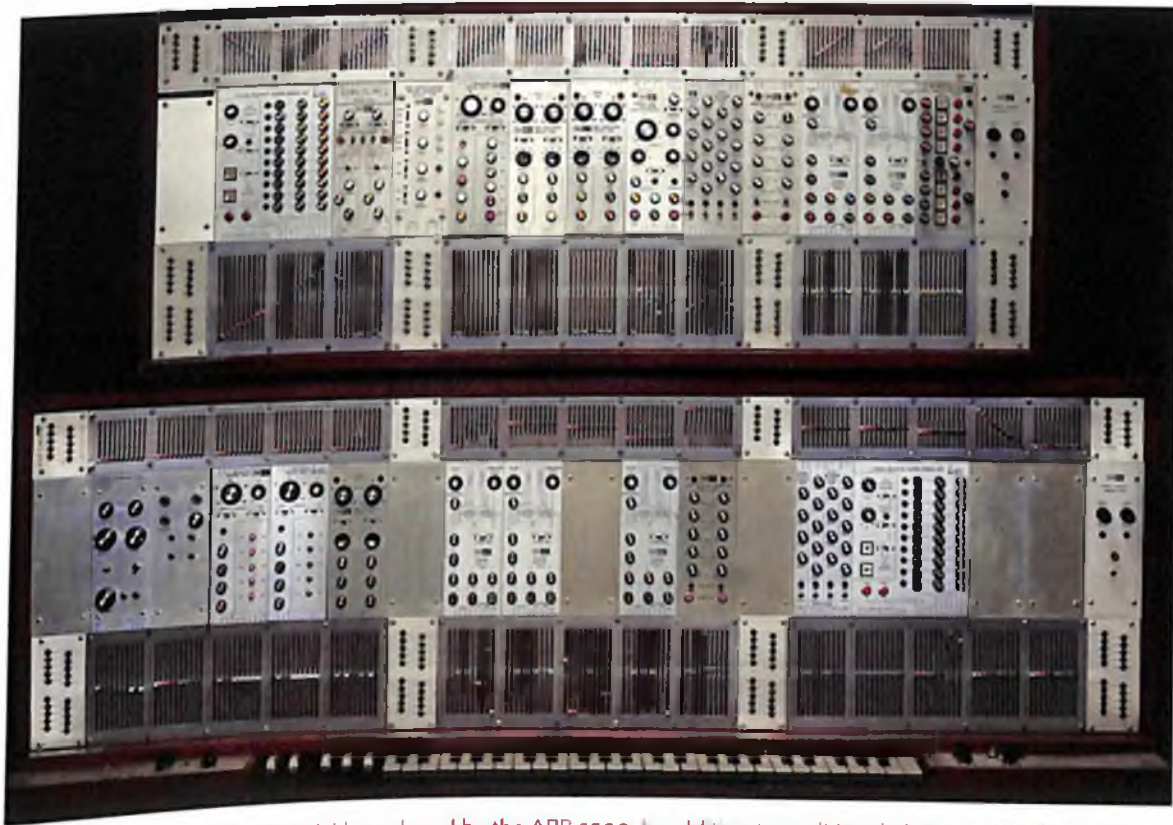


Photo by Joseph Escamilla

The early 2000 models are quickly replaced by the ARP 2500. In addition to traditional electronic music studios, users range from Pete Townsend of The Who to Tibetan Buddhism-influenced composer Eliane Radigue. This ARP 2500 sits in the studio of Hans Zimmer.



The Electrocomp EML-100, the first semi-modular synthesizer. Photo: tohnetweakers.com

Electronic Music Laboratories (EML) release the ElectroComp EML-100. It is possibly the first 'semi-modular' synthesizer in that its entire voice was pre-wired internally, but some of the routing could be overridden with patch cords. A four-VCO synth with a multimode filter and ring modulator, it also features what many say is the first 'duophonic' keyboard, which can independently output two independent voltages when two keys are held down.

Serge Tcherepnin joins the music faculty at the California Institute of the Arts. There he sets up a lab for the design of circuits for use in the arts and music.

Dave Rossum's PhD adviser Harry Noller invites Dave to help the music department at the University of Santa Cruz (UCSC) unpack their new Moog Model 12 synthesizer. "I catch the synthesizer bug, help teach the music students how to use the Moog, and study the schematics that came with it." Dave invites some friends from California Institute of Technology (Caltech) to play with it, and they decide they can build a synthesizer of their own. This is the genesis of what becomes Ep Systems.

EMS offers a VCS3 repackaged into a portable plastic briefcase, known as the *Synthi A* (nickname: Portabella, reportedly a pun on the name of London's Portobello Road).

1971 also sees the release of the massive *Synthi 100*. It is essentially three VCS3s, although the circuit boards are unique to the *Synthi 100*, and overall it was known for being more stable than the VCS3. It uses two 60x60 pin matrix patch bays: one for signal routing, and one for voltage control.

Dave Rossum learns electronics, and etches circuit boards for a homebrew synthesizer in his dorm room at UCSC. Over spring break, he returns to Caltech and assembles the *Black Maria*, their first synthesizer prototype. It uses matrix switches akin to the ARP 2500 for patching. Dave recounts "It worked, but we knew it was not a real synthesizer. We push it out the Caltech Dabney House library window, and it crashes to pieces in the courtyard. We removed the expensive matrix switches first, but never used them again because they had horrible crosstalk."

The ARP 2600 version 2.0 from 1971



Three VCS3s plus more: the massive EMS Synthi 100

Photo: courtesy of National Music Centre (NMC), Object Number 2002.05.10.1.6

1971

Using a small inheritance, Dave pays for himself, Paula Butler, Mark Danziger, and Mark Nilson from UCSC, and Jim Ketcham and Steve Gabriel from Caltech, to spend the summer building "a real synthesizer." The result, the Ep 25, is a competent fixed front panel synthesizer, akin to the contemporary ARP 2600.

Dave admits many of their design ideas came from the documentation for the ARP 2600 and Moog Model 12. "The original Ep 25 Mk I goes to Steve and Jim, and we all agree each of us can use what we developed as we see fit."

The ARP 2600 semi-modular synth - designed by Alan Pearlman and Denis Colin - is introduced. David Friend sketches out the 2600's front panel, including the block diagram illustrations, the final graphics are laid out by his wife (and later, noted calligrapher) Margaret Shepherd. Margaret appears in ads holding the first generation 2600 to emphasize its portability.

David explains that the goals were to make it cheaper, simpler, more portable than the 2500, delivering "80% of the sound for 20% of the effort." It is widely adopted by musicians as well as electronic music studios with smaller budgets.



ARP 2600 owned by Jim Blair. Photograph by Martin Smart

Dave Rossum and friends hear of an ARP 2600 at Moyer's Music in Santa Clara. They visit the store, and Dave starts "running diagnostic patches to determine its actual performance specifications" and are given permission to disassemble it. Discovering that their own ideas were ahead of what others were already selling, "We decide we are skilled enough that we can design a competitive product."

As a result, they announce the *Ep Modular Synthesizer* and associated plug-in 'submodules' - building blocks such as a VCO core for others to create their own synths - are for sale.

One of their innovations is the use of internal patch cords for the main jacks; plugging into the associated jack on the front panel with an external cord overrides this normalised connection. Other innovations for a commercially-available synth include 'soft sync' between VCOs, a digitally scanned voltage controlled synthesizer keyboard, and variable portamento shape for the keyboard.

Bernie Hutchins starts publishing *Electronotes* magazine. This long-running collection of synthesizer circuits and design ideas provides inspiration for numerous synthesists and modular creators. Dave Rossum is among its early contributors.

Serge Tcherepnin teaches a workshop to make your own simple modular synthesizer for summer school students. In the fall, he starts work on the design of a full-fledged analog synth, assisted by Randy Cohen and Rich Gold.

On the other end of the scale, PAiA Electronics offers their budget 2720 modular synthesizer for sale as both kits and assembled modules. Being the most affordable modular offering available, many modular musicians get a PAiA as their first modular. Unsurprisingly, the sound quality is roughly equivalent to its price.



Photo: Scott Lee / PAiA Corporation

Dave Rossum recounts that Bob Moog writes to Ep "and tells us nobody will take us seriously, and we won't be able to stay in business anyway, unless we raise our prices, which we do. As a result, more orders start flowing in."

Serge Tcherepnin gives the first ever demo of a complete *Serge Modular Music System* at the University of California in La Jolla "with quite a bunch of people ogling - among them Max Matthews, Warren Burt, Mort Subotnick, Roger Reynolds, and Don Buchla. Don Buchla took me aside after the show and kindly offered me his advice: 'You know Serge, there's no money to be made from manufacturing synthesizers.'"

Despite this, Serge decides to go ahead with his project for a 'People's Synthesizer,' offering a complete synth in kit form to the first twenty people willing to put up \$600. "Over the summer and fall a group of about seven of us started building the synths on a balcony kindly lent to us by the Music Department at CalArts." Composer Jill Fraser (p. 242) is among the early adopters and employees.

Doug Lynner's 'Mystery Serge' - believed to be the first *Serge Modular Music System* sold commercially - updated and refurbished by composer and Serge specialist Kevin Braheny Fortune. The *Mystery Serge* got its name as some of the graphics no longer reflect the modules or features behind some of the panels.

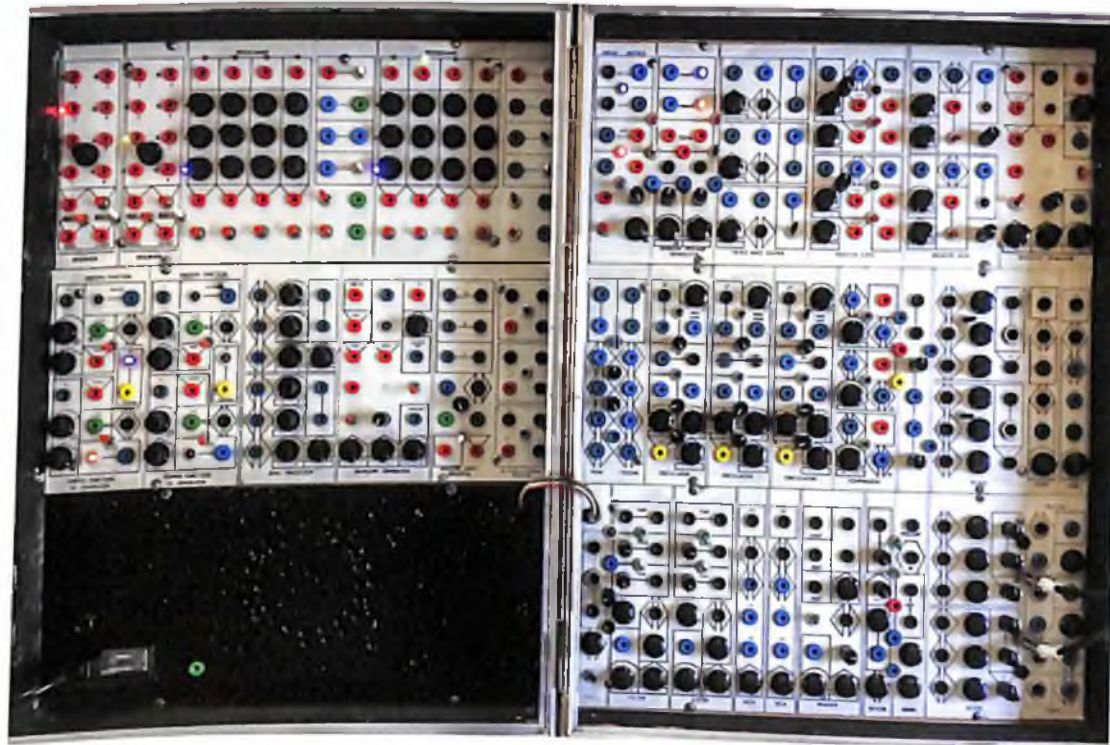


Photo: Doug Lynner

The Buchla Music Easel portable patchable synth is released. It contains the *Timbre* sub-module, which is recognized as the first wave folder. See also p. 178.



Photo: Dave Brown

1974

Nyle Steiner publishes a modification to the basic Sallen-Key filter circuit in the December 1974 issue of *Electronic Design* magazine. He extends the design by adding three 1 k Ω resistors and a three position switch, used to route the audio input signal into one of three different sections of the circuit to create different filtering modes. This basic design is used in later Steiner-Parker synthesizers, as well as by Arturia in their contemporary *MicroBrute*, *MiniBrute*, and *MatrixBrute* synths.

The Steiner-Parker *Synthesystem* released in 1975.



Photo: Nyle Steiner

1975

Nyle Steiner and Dick Parker release the Steiner-Parker *Synthesystem* modular synth. As with most modular systems of this era, it followed its own format for module height and width. A voltage-controlled phase shifter and a frequency divider are among its more unusual modules.

Ron Folkman and Alan Pearce - the "Rogue Moog Engineers" - start to become disenchanted with life under Norlin Industries. Ron relates: "Alan and I had already completely identified the shortcomings of the Moog products, such as drifting oscillators and intermittent keyboards."

Alan starts Polyfusion; the first product is the non-modular AS-1 analog sequencer. He brings in Ron to help sort out some problems with it, and Alan offers Ron a full-time job. Ron becomes vice president of Polyfusion.

Steve Porcaro's Polyfusion *Rootus* synth.



Photo courtesy of Steve Porcaro

Wolfgang Palm goes into business building PPG *System 100* and *300* modular synths. Early customers include Chris Franke and Edgar Froese

of Tangerine Dream, who Wolfgang credits with helping him start his business. Palm eventually releases the influential PPG *Wave* synths.



Photo: Amazona.de

The Japanese join the party

After the flurry of activity in the United States and parts of Europe, Japanese companies Roland and Korg decide to branch out from their previous self-contained keyboards to create patchable modular systems. Several other new modular synths appear as well, including a kit out of Germany that unwittingly starts the rebirth of modular synths two decades later.

1976

Roland releases the *System-700* modular synthesizer: the first large-scale modular system from Japan. Up until this point, Roland's previous synths – the *SH-1000*, *SH-3*, *SH-2000*, and *SH-5* – focused on simplifying complicated operations and on being affordable. Roland Corporation President and CEO Junichi Miki notes "These factors played an important role in making synthesizers popular. However, the downside to focusing on simplicity was a loss of flexibility." He shares that Roland's founder Ikutaro Kakehashi "had heard the previous modular synthesizers from Moog, and wanted to see how Roland could develop the modular concept – and so the project began."

Photos: Vintageworks



Roland also releases the *System-100* semi-modular synth. It comes in several sections:

Synthesizer 101: A monophonic synthesizer with built-in keyboard, oscillator, filter, ADSR envelope generator and attenuator.

Expander 102: The same synth engine as the 101 with the addition of a ring modulator and sample and hold, but without the keyboard. It is often paired with the 101 and placed behind it as an expander.

Mixer 103: A four-channel stereo mixer with built-in spring reverb, stereo panning, and effects send/return.

Sequencer 104: A two-channel, 12-step sequencer to automate playing looped bars of notes. (Their *System-700* was also notable for having a 12-step sequencer, instead of the standard 8 steps.)

Monitor speaker 109: A pair of 6.25 inch (160 mm) speakers.



Photos: Roland Corporation

PAiA Electronics release their upgraded 4700 series modules, again as kits or assembled units. Whereas the 2720 series of modules were simpler circuits mostly based around transistors, the 4700 packed more features into similar-sized circuit boards, and included more ICs.

Polyfusion releases their Series 2000 modular synthesizer. The 2020 VCLPF - modeled on an original OTA-based design by co-founder Ron Folkman - is the first module. Their modules do not fit any of the other standard formats of the time. This was a conscious decision on their part not to be associated with the Moog, as it had gained a poor reputation for stability. Polyfusion forges a reputation for being one of the highest quality modular systems available at the time.



1977

In the May 1977 issue of the German electronic DIY magazine *Elektor*, the first of a series of articles devoted to the creation of the Formant modular synthesizer appears. Designed by Cyril Chapman, it is said to have the performance of many commercial models, but is designed for home construction and could be built for a fraction of their cost. Instructions covered building a keyboard and interface, power supply, VCO, VCF, triple LFO, noise source, ADSR, VCA, output module, resonance filter module, and a 24 dB VCF. Dieter Doepfer is among those who build their own Formant synth.

Korg's founder Tsutomu Katoh has sets a strict policy for his company: Never imitate any product from other makers, and always strive for originality. Their PS-3100 and PS-3300 - the "world's first fully polyphonic patchable synthesizers" - certainly qualify. Although they use an organ-like top-octave divider circuit for oscillators as well as independent filters and VCAs per note, they do have a set of shared patch points for modulation of oscillator frequency, filter cutoff, etc. where the signal carried on one patch cord is shared to all of the notes. They are designed to be both self-patched, and to cross-patch with other modulators.

Ruben and Serge Fernandez meet Klaus Schulze, who introduces them to the EMS *Synthi A*. Inspired, they design and produce the RSF Modular 11 (also known as the *Série 11*) modular synths. About twenty of these systems - some of them housed in Samsonite suitcases, echoing the case for the *Synthi A* - are sold, including more than 300 modules.

The RSF *Série 11* modular synth, which predated their much better known *Kobol* synthesizer

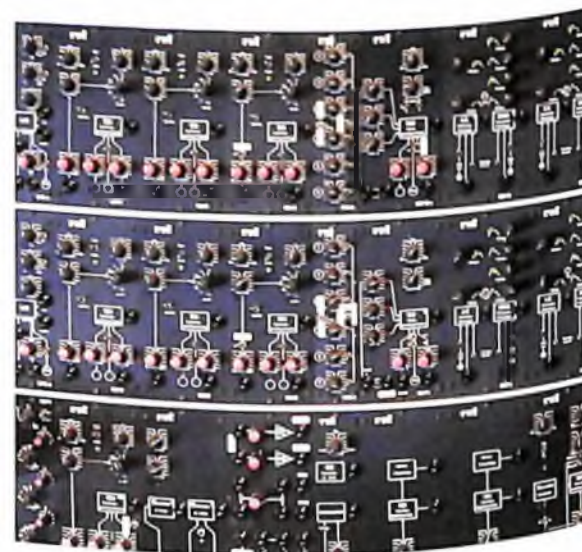


Photo courtesy of Steve Porcaro



Ramses and Ophelia, two of the cabinets of Steve Porcaro's large Polyfusion modular system that he played in the band Toto.

Photo: Oliver Groll

The Korg MS-20 monophonic semi-modular synth, now known for its distinctive filter.



The PS-3300 polyphonic, patchable synth took a different path, just as Korg's founder Tsutomu Kato dictated.



The Korg PS-3200 programmable, patchable, polyphonic synthesizer.



The modules in the Roland System-100M still inspire designers today.

1978

Korg releases the MS-10 and MS-20 semi-modular monophonic synthesizers with the goal of creating inexpensive patchable synths that serve both as learning tools and to appeal to young users.

Korg also releases the PS-3200 programmable - but still patchable - polyphonic synth.

Roland releases the smaller System-100M modular synthesizer.

Darkness falls - almost ...

The next 15 years sees many modular instruments discontinued, and companies both big and small close their doors. However, amid all this darkness, a glimmer of light appears: Dieter Doepfer gets the synthesizer bug, and decides to start selling kits and instruments.

1979

Roland discontinues the *System-100*.

Steiner-Parker closes.

Aries announces a semi-modular pre-assembled synthesizer, but it appears not to make it into production before Aries closes their doors.

EMS officially closes. Its assets are bought by Datanomics, a company that previously specialized in motorized hospital beds. They continue making *VCS3s*, *Synthi AKSs*, and *EMS Vocoders*. Datanomics eventually realizes diversifying into the music market was a bad idea, and sells the company to composer and EMS user Edward Williams. In April 1995, Robin Wood - who remained an EMS employee through the various ownership changes - acquires the full rights of EMS. He continues to produce the *Synthi A*, *VCS3* and *Vocoder 2000* in limited quantities.

When Dieter Doepfer finishes building his *Elektor Formant* modular synth, he feels some features are missing, "so I began to develop some *Formant* compatible modules, including a voltage controlled phaser, a frequency divider, a envelope follower, a voltage controlled waveshaper and some more." He starts offering some of these for sale, starting with the voltage controlled phase shifter. He goes on to design numerous card-based synthesizers as well as MIDI equipment.



Elektor Formant modular synth.

1980

After releasing three different models and color schemes, ARP Instruments discontinues the ARP 2600.

1981

After discontinuing the ARP 2500 and 2600, a bankrupt ARP Instruments is bought by the Musical Instrument Division of CBS. CBS releases the last ARP-designed instrument - the *Chroma* polyphonic synthesizer - under the Rhodes brand name.

Roland Corporation discontinues the *System-700*.

Buchla pioneer Suzanne Ciani scores the Lily Tomlin movie *The Incredible Shrinking Woman*. Sixty years after the start of the Equal Rights movement for women in the United States, she is the first solo female composer of a major Hollywood film.

1983

Dave Rossum recalls that "With the advent of the *Prophet*, and particularly the *DX-7*, modular synthesizer sales completely dry up. We discontinue the *E-mu Modular System*, and move on to all-digital synthesis."

Polyfusion stops making modular synths, although the company continues to exist as a contract manufacturer of a wide variety of electronic systems. They continue to service existing Polyfusion modulars.

1984

Roland discontinues the *System-100M*.

1986

The PAiA 4700 series appear in a catalog for the last time, and is discontinued.

1993

Moog Music officially ceases operation.

Inspired by the vocal sounds on an album by Isao Tomita, Bob Williams and Steve Gay design the *FB3 Filter Bank*, the first Analogue Systems product.

New Formats Appear

After a low period, prices of vintage synthesizers - including modular systems - start to skyrocket. This tempts several new players to enter the market, creating new formats that are considered the de facto standards today.

1994

Doepfer releases the accidentally successful *MS-404* MIDI synth module. Dieter recalls: "When the prices for second-hand Roland *TB-303s* inflated, I decided to go back to my roots and designed the *MS-404*. It was a stand-alone MIDI-controlled monophonic analog synth. I went for a first series of maybe 50 or 100 pieces." In just two months after it was announced, "already 500 orders were made, we were fully pressed to the wall."

1995

Doepfer *MS-404* customers are asking for added features, such as a second VCO or ADSR. Dieter recounts: "Because of the big success of the *MS-404* I saw a chance also to rise the modular synth from dead. The *A-100* was born and is the base of what is now called Eurorack. The first modules were nothing but the circuits taken from the *MS-404* and converted into individual modules."

"When I introduced the *A-100* for the first time at the 1995 Musikmesse (a large annual music industry trade show in Frankfurt, Germany), it was often laughed at and many people said that no one needs this kind of music these days." However, Dieter's main business at this time is focused on MIDI keyboards and other MIDI equipment, so he was happy to take on modular synths as more of a personal project. And, used modular systems from the first era were starting to come back in demand. "I already knew that there would be some interested parties for such a thing. But it could not be foreseen that it would become a 'mass phenomenon' with several hundred companies and well over a thousand different modules."

Current
Analogue
Systems
system.

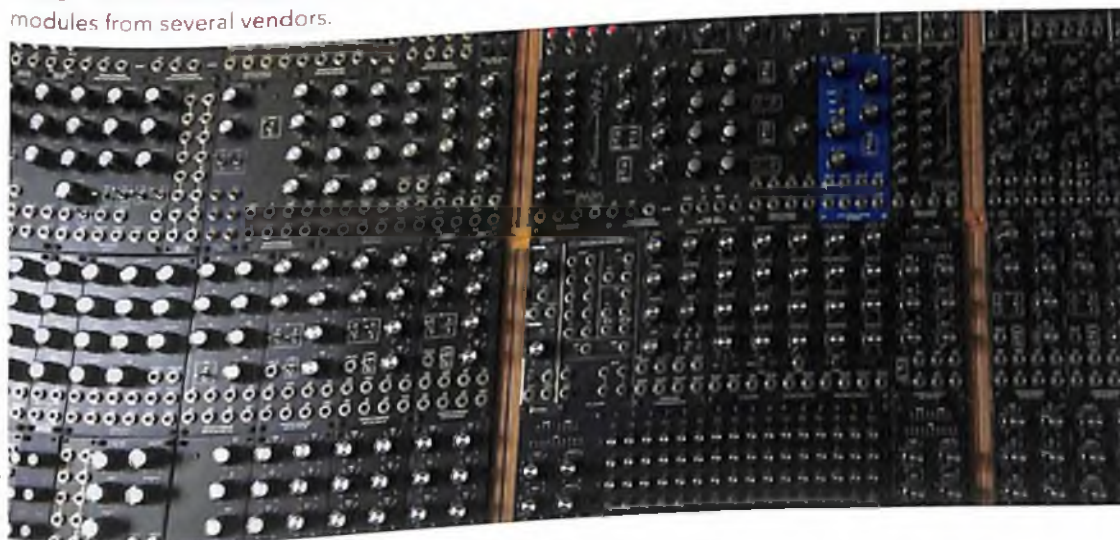


1996

Analogue Systems develops a modular version of their *FB3 Filter Bank*. It consists of a 3U 84HP rack with the *RS170* multiple, *RS160* mixer, *RS80* VC LFO, and three *RS110* multimode filter modules. This eventually grows into a full system of modules designed to be an affordable option for musicians to learn patching and to create new timbres.

They do this work in parallel with Doepfer; they use the same case size, but end up choosing different power connections and mounting screw locations. Fortunately, both systems use the same power supply voltages, so adaptors between the two formats can be made.

A large MOTM-format system featuring modules from several vendors.



1997

Roger Arrick - founder of Synthesizers.com - admits the synthesizer bug bit him when he was just eight years old, and his brother brought home a copy of *Switched-on Bach*. He played with DIY circuits in the mid-70s "when I was around 14 or so. At that point I cared more about the logical layout of panels, implementing modularity and improving intuitive operation than the details of circuits. Much of my early electronics understanding came from *Electronic Notebooks* written by Forrest Mims III and distributed through RadioShack. Beyond that is mostly data books from component manufacturers. I read them like others read novels."

Fast-forward to the 90s: Roger owns a small electronics company, and with the budding resurgence in modular synthesizers, realizes he is "in a good position to manufacture these cost-effectively. The driving force was the memories of expensive modulars that kept them out of reach in the early days - for me, and so many others."

"I decided on a marketing strategy to name the company an internet domain name. In 1997, the internet was still in the early phases. Many domain names were still available, and I snatched up Synthesizers.com. The rest is history, as they say."

Roger's plan was to have most if not all of the required system components available the first day he officially opened for business "so I wouldn't get a bad reputation, especially after numerous past debacles where companies and people made promises they couldn't keep." So out of the public's eye, Roger goes to work ...

Paul Schreiber decides to turn his personal love affair with synthesizers into a source of income. Paul picks up the story: "The idea came to offer just a blank PCB board with highly detailed instructions and documentation. The customers could 'subscribe', like to a magazine, and periodically get a new board in the mail. There would be just the board and the documentation, no additional parts." The name of the project was 'MOTM' for Module of the Month. He decides to "go full Hewlett-Packard" and focus on quality, and chooses a panel size: 5U tall and 2U wide. He gets requests for full kits instead. After a pause to adjust his business plan, the *MOTM-100* is offered for sale in February 1998, with modules designed by Paul as well as Jürgen Haible, Scott Rider, Neil Bradley, Doug Kraul, and others. Many synthesists such as Robert Rich (p. 126) still rely on their MOTM systems today.

1998

Swedish company Clavia release the *Nord Modular Virtual Modular Synthesizer*. The idea is to create a software emulation of a modular hardware synth, where the selection of modules and signal routing is user-definable in software rather than requiring patch cables. Today, numerous virtual modular synths - including ones released by Korg and Moog - are available; many will even run on your phone. This is a very cost-effective entry point for musicians interested in the power of modular synthesis, but without the budget or physical space for a 'real' modular synth.



Modular synths turn digital with the introduction of the Clavia Nord Modular Virtual Modular Synthesizer.

Still made today, Wiard's designs have inspired several Eurorack format modules.

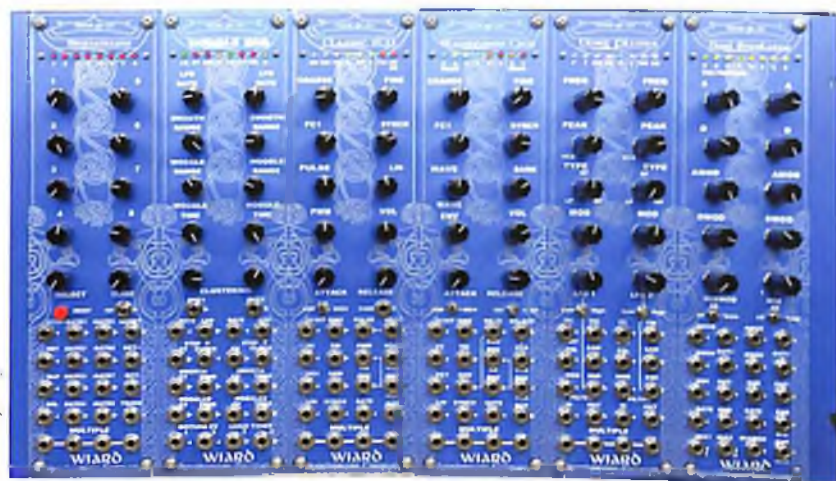


Photo by Cary Grace

1999

Grant Richter starts Wiard on the annual Mexican celebration day, Cinco de Mayo. Designed to be ergonomic, the modules are larger than most other formats at 6 rack units high.

Grant likes to say that "I freely admit that all my design work is derivative. This is the essence of engineering. If everyone had to start with a square wheel and figure out a round one, we would all, literally, be nowhere. So all my work is based upon ideas from designers that went before me whom I admire - however, I am no plagiarist. If I could not 'up the game' to my satisfaction, then I left it alone."

2000

After working for nearly three years designing modules and cases, Roger Arrick goes public with Synthesizers.com, including a full range of modules.

One of Roger's best moves was creating a Technical page on his web site that detailed all of the mechanical and electrical specifications of his modules. It is based around the size of Moog modules, but with an updated power supply and connector, as well as a set of voltage levels that treat sound and control voltages the same. This makes it easy for other small companies and DIY builders to create modules compatible with the 'dotcom' system, which is now the de facto standard for 5U modular equipment.

Rebirth & Growth

2003

The 2000s sees the acceleration of the Eurorack format into the mainstream that it is today. Several previous players in the modular world also re-enter the market, introducing brand new instruments as well as tributes to earlier classics.

Analogue Systems licenses the circuit designs of the VCS3 from Robin Wood of EMS. The first modules to come from this include the RS500E Synth Filter and the RS510E Trapezoid Generator.

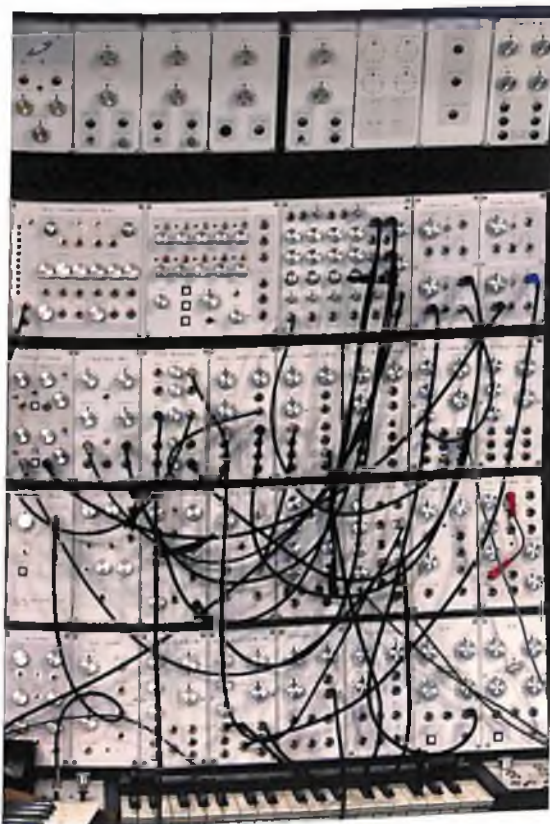
2002

After a legal battle over the name, Robert Moog regains his rights to Moog Music, which Bob adopts as his company name replacing Big Briar. One of his first products is the Piano Bar, a MIDI retrofit for acoustic pianos designed by Don Buchla.

Paul Schreiber of MOTM decides to get out of the module kit business. He reappears seven years later creating already-built Eurorack format modules.



Synthesizers.com re-introduces and updates the standard for Moog format modular synths. The name was also a clever bit of early internet marketing.



2004

After forays into self-contained digital and hybrid instruments as well as a series of innovative controllers, Buchla updates the 200 Series modules to become the 200e. A major feature is support for a *Preset Manager* which can record and duplicate front panel control settings. Note that the player still has to re-patch the same connections between modules to recreate a sound; some Buchla owners like Joel Davel report it's fun to recall a preset with a different patch scheme to generate new ideas.

Ray Wilson starts *Music From Outer Space (MFOS)*, offering kits of roughly 30 different synthesizer modules, non-patchable synths, and other noise makers. Many DIY modular synth builders cite MFOS as a major influence on them. *SynthCube* takes over the product line after Ray's passing in 2016.

Music From Outer Space has inspired a new generation of DIY builders and modular synthesizer enthusiasts.



2005

Three companies band together to simultaneously announce new modules for the Eurorack format. They include Livewire (*Dual Cyclotron*, *FrequenSteiner*), Oakley Sound (*Wavefolder*, *ADSR/VCA*, *Octal Resonator*, *State Variable Filter*) and Plan B (*Model 12 State Variable Vactrol Filter*, *Model 13 Dual Timbral Gates*, *Model 17 Event Timer*). Many see this as an inflection point where Eurorack format - announced 10 years earlier - finally starts to take off on its exponential rise. Today there are with well over 100 manufacturers producing thousands of modules in the Eurorack format.

2006

Mark Verbos (p. 136) starts building a handful of Buchla format modules, and builds a name for himself. Today, Verbos Electronics is considered to be one of the premium manufacturers of Eurorack format modules.

2008

After having previously worked for Moog Music, Tony Rolando founds *Make Noise* (p. 52). Instead of sticking to the East Coast approach Moog is known for, *Make Noise* quickly builds a reputation for releasing atypical, experimental modules with a strong West Coast influence. They become one of the most successful Eurorack format synthesizer manufacturers, proving the resurging modular market is far more than just a fad.

Moon Modular (p. 122) releases their first module: the *M563 4 Channel Trigger Sequencer*. Founder Gert Jalass had been restoring Moog modulators during the late 90s, and occasionally has users ask if he could build something that would allow them to synchronize multiple Moog 960 sequencers. He was positively "not aware of the 'Pandora's Box' I opened ..."



Danijel van Tijn, after years designing analog circuits as well as modeling sequencers and synthesizers in Max/MSP, founds Eurorack manufacturer Intellijel Designs Inc. (p. 264).

2009

After multiple requests from musical instrument dealers to create a Eurorack version of his *Geiger Counter* guitar pedal, William Mathewson founds WMD (p. 202).

Dan Green - another person with roots in the guitar pedal business - starts creating Eurorack format modules under the name 4ms Company (p. 294).



2010



Paul Schreiber of MOTM fame gets back into the modular synthesizer business, announcing his first Eurorack module - the *E340 Cloud Generator* - on Valentine's Day, 2010. He uses the company name Synthesis Technology, including the same synthtech.com web site he initially set up in 1988 to sell Curtis chips.

2011

Grant Richter decides to get out of manufacturing synthesizers, passing his business Wiard onto songwriter/composer Cary Grace and Wessex Analogue. Grant teaches Cary how to build the hand-made 300 Series modules.

In the meantime, other Eurorack format companies license several of Grant's designs, including Malekko Heavy Industry with versions of the *NoiseRing* (a relative of the *Turing Machine* - p. 255) and the *Dual Borg* (a cross between a Buchla *Low Pass Gate* and Korg *MS-20* filter). The most successful has been the updated Make Noise version of the *Wogglebug* (p. 256).



2012

Tom Whitwell publishes an open source version of the *Turing Machine* random pattern generator module. Someone starts selling kits of it, and Music Thing Modular (p. 248) is born.

Mutable Instruments (p. 284) also gets their start selling DIY kits of desktop synths. Today their modules are among the most popular in the Eurorack format.

A pair of contemporary art exhibitions inspires Andreas Zhukovsky to start creating colorful, fanciful yet powerful modules under the Endorphines name (p. 214).

2013

Korg re-releases the *MS-20* in a variety of formats. Over the years it is available in a variety of formats, including mini and full-size versions, and as a kit. (It was actually preceded by Korg's own software emulation of the *MS-20*.)



Buchla Electronic Musical Instruments re-release the *Music Easel*, which proves to be an attractive entry point for many eager new Buchla musicians.

Joining the DIY module movement, Girts Ozoliņš founds Erica Synths (p. 156) in Latvia to offer modular recreations of the famous Russian *Polivoks* synthesizer.

Another Eastern European company - Bastl Instruments of the Czech Republic (p. 188) - taps into the local electronics DIY community creating an intriguing range of modules including solenoid and servo controllers to interface your modular to the physical world.

2014

Moog Music Inc. recreates Keith Emerson's famous towering *Moog Modular Synthesizer*. The press release is dated April 1, so many think it is a joke, but the unit is indeed real and for sale. This serves as the 'test case' to see if Moog can accurately recreate their original modular synthesizers.



Noise Engineering (p. 304) starts as a hobby for husband and wife team Stephen McCaul and Kris Kaiser. Their non-mainstream approach to creating unique modules quickly catches on; it becomes their full time occupation in 2016.

Arturia release the successor to the 2012-success, the *MiniBrute*: The new, smaller *MicroBrute* semi-modular synthesizer has a small patchbay and becomes a popular gateway to modular synthesis for many.



2015

Moog Music Inc. re-releases the modular *Moog System 15, 35, and 55*, built as identically as possible to the original units. They reportedly sell more systems than Moog did with the original modular synthesizers.

They also release the *Mother-32* semi-modular synth in the Eurorack format. It proves to be extremely popular, as an entry point for many new modular synthesists.



Roland releases the *System-500* modules, with black panels to reflect their *System-700*, and circuits based on their *System-100M*. It is a collaboration between Roland and Joshua Holley of US manufacturer Malekko Heavy Industry.



Simone Fabbri starts *Frap Tools* (p. 76), initially offering Eurorack format cases. They now make some of the deepest non-menu modules available.

2016

Ron Folkman of Polyfusion gets the modular synth bug again, but to date is unable to find the right partner. He is then approached by Jim Soloman and Jammie Logan of Logan Soloman. Ron shares that "after seeing Moog's successful return to their modular roots and much vetting of Logan Soloman, I was convinced that 'if we would build it - they (musicians) would come.'"

Logan Soloman premieres a monosynth based around modular circuitry later that year at Knobcon in Chicago, with intentions of re-releasing a full modular synth in the imminent future. "I truly feel rejuvenated in my 70s and my mind has been working overtime thinking of new modules and how to bring modular forward again."

Dave Rossum returns to modular synthesizers with the release of the Eurorack-format Rossum *Electro-Music Evolution Variable Character Filter*, based on the design of the 1973 E-mu Systems 2100 low pass filter module and 1100 filter sub-module.

The Moog *Mother-32* created attention and demand of small semi-modular synths the year before. Now, Make Noise release the *O-Coast* semi-modular synthesizer with its name reflecting that it utilizes techniques from both the East and West Coast paradigms. The *O-Coast* becomes highly successful and is just the tip of the iceberg in a new wave of small semi-modular synthesizers emerging from different manufacturers in the years to come.



2017

Moog Music Inc. unveils the *Drummer From Another Mother (DFAM)* semi-modular percussion synthesizer and sequencer as a DIY build at Moogfest 2017, and releases it to the general public in 2018.

2018

Kim Bjørn and Chris Meyer creates *PATCH & TWEAK*, the first contemporary and fully illustrated book on modular synthesis in decades. It was funded within 10 minutes on Kickstarter, and published by Bjooks, Kim's publishing company established after the success of his first book *PUSH TURN MOVE*. Sorry, we just had to :)

To be continued...